SCIENCE

VOL. 84 FRIDAY, DECEMBER 11, 1936 No. 2189

New Vantage Grounds in the Psychology of Music: PROFESSOR CARL E. SEASHORE 517

The Effects of American Environment on Immigrants and Their Descendants: PROFESSOR FRANZ BOAS 522

Obituary:
Alfred McLaren White: PROFESSOR EDWARD MACK, JR., PROFESSOR F. H. EDMISTER and DR. E. C. MARKHAM. *Albert B. Reagan:* J. H. S. *Recent Deaths* 525

Scientific Events:
The Rockefeller Foundation and the Kaiser Wilhelm Institute; A Fraudulent Academy of Sciences; Annual Report of the Chief of the Weather Bureau; The Sumatra Expedition of the National Geographic Society and the Smithsonian Institution; Annual Meeting of the American Society of Mechanical Engineers; First Annual Symposium of the Division of Physical and Inorganic Chemistry of the American Chemical Society; The American Science Teachers' Association 526

Scientific Notes and News 529

Discussion:
Do Brain Waves Have Individuality?: PROFESSOR LEE EDWARD TRAVIS and ABRAHAM GOTTLOBER. *The Use of the Terms Coenocyte and Syncytium in Biology:* PROFESSOR REXFORD F. DAUBENMIRE. *The Black Widow Spider in Virginia:* DR. G. W. JEFFERS 532

Special Correspondence:
New England Intercollegiate Field Trip: PROFESSOR LLOYD W. FISHER 534

Scientific Books:
An Invitation to Mathematics: PROFESSOR ALBERT A. BENNETT. *British Association Mathematical Tables:* DR. D. H. LEHMER 535

Special Articles:
Inactivation of Tobacco-mosaic Virus by X-Rays: DR. JOHN W. GOWEN and DR. W. C. PRICE. *Vertebrate Remains from Cenozoic Rocks:* PROFESSOR C. E. NEEDHAM. *Contamination and Compaction in Core Sampling:* WILLIAM F. WRATH 536

Science News 6

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

NEW VANTAGE GROUNDS IN THE PSYCHOLOGY OF MUSIC[1]

By Professor CARL E. SEASHORE

THE STATE UNIVERSITY OF IOWA

THE Baconian series of lectures was established for the purpose of furnishing from time to time a highlight review of the state of progress in given fields of knowledge. Ten years ago, I had the pleasure of giving the first lecture under this new organization. At that time I reviewed the status of the psychology of music. Since that time much water has run under the bridge, and this evening I have the pleasure of returning to the same subject with the satisfaction of reporting gratifying progress.

I. MEASURING INSTRUMENTS

The progress that has taken place in the last decade by leaps and bounds is due to the extraordinary development of recording, measuring, transmitting and generating instruments by electrical engineers. We see this progress exemplified in the radical changes which have taken place in the recording of music by phonograph and film and in broadcasting over the radio. In acoustical engineering, as in every other science, there is a normal order of evolution. Each introduction of a new fundamental principle in physics or chemistry furnishes a vantage ground for further achievement. The recent development of the microphone and the thermionic tube has been revolutionary.

By the use of such tubes, a sound may now be amplified a million times. A sound made by a parasite squirming and crunching in a grain of wheat may be amplified so as to disturb the conversation in an adjoining room. Such amplification we hear every day in listening to our radios. We may now pick up the minutest characteristic of a single vibration in a tone

[1] An address in the Baconian series of lectures at the University of Iowa, November 13, 1936.

and isolate it, magnify it, modify it under experimental control, and measure it to the limit of all practical and theoretical needs.

Perhaps the most significant application of extraordinary amplification lies in the possibility of picking up nerve impulses in any part of the nervous system, tracing their course in rich ramifications, detecting their occurrence and measuring duration and intensity of sensory impressions as well as the response to nerve impulses in the muscular mechanism of the body. This is known as the action-current technique. The flow of a nerve impulse generates an electrical current which corresponds in many respects to the nerve impulse itself. This current is amplified and can be studied in great detail. When I bend my forefinger, this is the result of the discharge of nerve impulses from the central nervous system into the muscles of the finger at a rate sufficiently rapid to keep the finger from trembling. The action currents from these nerve impulses are picked up and may be converted into sound waves, giving a tone which may be heard as loud as a man can roar. Of course, these waves may be sent around the globe and may come back to me and be heard while the finger is still bent. By the same technique we can measure hearing ability in man or in any of the lower animals by measuring the action-currents which flow through their auditory nerves as a result of sound stimulation. For many purposes measurements on the nerve impulse are more accurate and there are far more possibilities than the traditional psychophysics methods through hearing.

By such action currents we can even measure various aspects of activity in the brain. For example, it is possible to detect the exact moment that a person sees light or has a dream. If I should be far off in London, sleeping in a hotel, and my wife should want to know if I was sleeping well or dreaming, she could ask to have my brain waves cabled to our psychological laboratory and a laboratory assistant could tell from the characteristics of these whether or not I was sleeping soundly. By ordinary sound transmission she could, of course, hear whether or not I was snoring.

Likewise, in the field of producing synthetic tones, marvelous progress has been made so that it is now possible to produce practically any conceivable kind of tone for musical purposes. We are at the beginning of an era of radical revolution in the improvement of musical instruments on the basis of scientific measurements and in the substitution of comparatively simple electrical devices with infinite possibilities for modification of tone for organ pipes, strings, horns and drums. The Hammond organ is a step in this direction. In cooperation with electrical engineers, we have in the university built one tone as an experimental model for what might become an organ. With this generator, a tone may be made up of as many as sixteen partials in which it is possible to vary the number, the distribution, the relative strength, the phase relationship and the fundamental frequency in the sixteen partials. Any mathematician can tell us that this makes possible the production of more than a million changes in the character of that tone. By playing on this one instrument, it is possible to imitate the violin, the organ pipe, the tuning fork, the bass horn and even the bass drum; and every type of tone produced can be described and recorded in exact physical and mathematical terms.

But no musical ear can distinguish that many differences in tone. For that reason, a sort of keyboard has been built into the instrument on which one can set up the most desired tone qualities that can be heard and desired. These keys are operated like the stops on an organ. For a particular flute tone, a cornet tone, a clarinet tone or a specific organ quality, one can draw a particular stop and that quality of tone can be guaranteed, described and repeated. It is even possible to speak particular vowels, such as a, e, i, o, u, with considerable fidelity. We can look into the internal structure of a tone, trace the reverberation of its individual partials in the auditorium and follow their course through the ear, the nerve and the brain, and record their response in specific muscles.

These are but samples of acoustical experiments that have taken place in the last decade. With such instruments placed at the command of the experimental psychologist in the studio for the psychology of music, it can readily be seen that a new world of science is opened up. Musical tones have been harnessed, can be recorded, transmitted, built up in any conceivable variety of quality. Thus acoustics, the youngest of the sciences, has made its debut. All this culmination of achievement has taken place largely within the last decade.

II. The Adoption of Scientific Method

This acquisition for mastery of the musical tone has facilitated the adoption of strictly scientific procedure in the study of musical phenomena, so that those who are now pursuing the subject seriously can set up as criteria of scientific validity such sanctions as these: (1) The factor under consideration must be isolated in order that we may know exactly what it is that we are measuring; (2) this factor must be varied under control while other factors are kept constant; (3) the observed facts must be recordable; (4) the situation must be repeatable for verification; (5) the conclusions must be validated in relation to the total personality in the total musical situation; and (6) the conclusion must be limited to the factors under control.

Adherence to such basic principles is now an attain-

able goal and one for which we must hold ourselves responsible in the science of music. With these principles as a criterion, we must, of course, admit that much of the amateurish work that has been done in the name of the psychology of music is condemned and must be done over again. On the other hand, the scientific approach to music is vastly enriched by the adoption of these principles because basic approaches to the science will be contributed through the cumulative development in underlying sciences; such as, physics, anatomy, physiology, mathematics and anthropology, all of which now are entering upon a new era in the form of contribution to phonetics and acoustics. The instrument maker, the musical performer and the composer now have new concepts and new effective tools placed at their command. It is the function of the psychology of music to organize, integrate and interpret contributions from all such sources in order that we may gradually build an applied science on musical experience and musical behavior.

III. Terminology and a Musical Pattern Score

The growth of knowledge of music in the manner just described is beginning to result in the clarifying of concepts, the definition of terms and the radical revision of musical language. Take such a concept as that of tone quality. Musicians have literally hundreds of names improvised under the influence of impulse and the necessity to designate this characteristic of tone. None of these terms have been defined or standardized in musical literature, but since we have taken the tone into the laboratory, it has been possible to analyze, define and describe characteristics of tone quality, so that any scientifically minded person can know exactly what the term means and what he means by it. For example, when, as a result of thorough-going experiment, we have defined tone quality, that definition can be formulated, verified and standardized, and the hierarchy of characteristics of tone quality defined consistently in terms of that definition, with the result that undefined, ill-adapted and confusing terminology now prevalent will gradually be scrapped.

Nobody is to be blamed for the existing jargon in this field. With the best of intentions, musicians have had to await the coming of scientific experiment. It is the business of scientists to develop the science of music; musicians must ply the art. But the musician must keep in cooperative touch with scientific development and absorb the new knowledge progressively.

An analogous development to that of musical terminology is that of musical symbols by which scientifically determined facts about the tone may be represented in a compact semi-diagrammatic form of notation which is capable of reporting scientific data in a new type of score which shall be musically significant. This has been accomplished in the introduction of what we call the musical pattern score in which the actual performance of a note is shown in minutest detail in the form of a simplified graph which takes the place of the conventional musical note. This musical pattern score has been simplified and condensed so that it is now possible to show in terms of this score exactly how a song or instrumental performance was rendered; and this can be done almost in the space occupied by the original musical score.

IV. Analysis of a Problem

In the pre-scientific stage, musical phenomena impressed one as of such infinite range of characteristics of an intangible nature that a scientific approach seemed futile and rash; but the actual scientific approach, when persistently pursued, dispels this confusion and attempts to make every aspect of the phenomena tangible. Let me give a few illustrations of actual vantage grounds that have been gained in recent years.

The psychology of music deals with the experience and behavior of the singer and of the listener. These are both approached through the study of the music as such, which is the message of the composer and the interpretation of the performer, and in turn becomes the stimulus for musical experience and behavior. The scientific approach, therefore, makes it desirable to begin with the music as such, a work of art, as distinguished from the creator or the person appreciating the creation. But this art object is often intimately tied up with words, dramatic action and countless influences of personality, audience, service to be rendered by the music. Each of these is significant for the music, but for the scientific purpose we may eliminate them entirely and say that in this work of art all that is transmitted from the performer to the listener is carried through the medium of sound waves. We, therefore, postpone a study of all the accessories and isolate the sound wave for study.

Sound waves, when adequately recorded, have four characteristics, and only four; namely, frequency, amplitude, wave form and wave duration. All these can be accurately measured, and in terms of these, all points of physical tone may be described. The adoption of this point of view simplifies our problem of approach and gives us positive assurance as to the possibility of measuring and controlling each and every kind of tone as a physical phenomena.

But we must now take the long leap to give this musical and psychological significance. We do not hear sound waves; we hear tones. The first step was to recognize that for each of these measurable aspects

of sound waves, there is a mental process. Frequency gives us pitch; the amplitude gives us loudness; the wave form gives us timbre; and the duration of sound waves gives us time. These are the four attributes of sensation in terms of which we hear, appreciate, remember, think and produce tones; so that we may say that, in terms of pitch, loudness, timbre and time, we may describe every musical experience of tone. This was a great step in the effort to make music tangible for scientific analysis. In the absence of that concept we should have continued thoroughly baffled by the apparent chaos and confusion of musical experiences.

But, with the progress of science, it was found necessary to modify the concept of the 1:1 relationship between the physical and the mental. Pitch is a psychological and musical term denoting experience and, while in general it is determined by the frequency of the sound wave, there are many exceptions depending upon a variety of objective and subjective conditions, such as the amplitude, the form and the duration of the sound wave. A tone of 220 vibrations does not seem to be of the same pitch in a loud tone as in a soft tone, in one characteristic timbre as in another, or in one limited duration as in another; and the same was true about the other three characteristics.

There is not always a ratio of 1:1 between the physical and the mental; but from this embarrassment we again found relief in the conception that the differences between the physical and the mental may be regarded as normal illusions and such normal illusions can be measured. The demonstration of this was an extraordinary achievement; thus, a vast field of the psychology of music consists of the description and explanation of normal illusion as a medium of musical art. Since there is much truth in the aphorism "All art is illusion. Thank God for illusions!", a great conquest was made in the establishing of the possibility of measuring these illusions.

But still another fundamental step had to be taken in the effort to measure and evaluate artistic performance and experience. This took the form of recognizing the possibility that beauty of music consists primarily in artistic deviation from the rigid—true pitch, even intensity, metronomic time, pure tone. It is difficult to comprehend the far-reaching significance of this conquest in the interest of scientific measurement. In the study of pitch intonation we rarely encounter a fixed pitch in musical performance. Indeed, the entire range for the expression of individuality, mode of interpretation, art, etc., in terms of pitch consists in artistic deviation from true pitch. This in all its forms can easily be measured, classified and described. The same is true of the other attributes of tone: loudness, time and timbre.

For each of these four variables, it was necessary to establish a sort of zero point for a measuring scale. Thus for pitch, the zero point is the frequency of the standard tone; for loudness, it is the absence of sound; for duration, it is the lapse of time in terms of a fraction of a second; and for timbre, pure tone. The taking of this step constituted the laying of a corner stone in musical esthetics, in that it furnished the means of interpretation for every aspect in the exhibition of musical art or in faults of the art, in an exact and verifiable way. Thus, since art is an appeal to feeling and an expression of feeling, we have here a scientific approach to the analysis, description and explanation of the expression of musical emotion, or feeling, in so far as that can be expressed in music.

The reaching of this vantage ground constituted a contribution to scientific psychology in itself in that it opened up a new field for reliable measurement of emotional expression. But our process of simplifying the approach had to be carried one step further. That was to recognize that the higher and more complex processes in music are all relatable to these four basic concepts. Mental images, whether in imagination or in memory, are in terms of the same attributes as we found in sensation. We can imagine or recall tones in terms of these characteristics of the image or names for them. Likewise, thought about tone must be couched in terms of these same concepts. And what is it that arouses musical emotion? In what terms is emotion expressed? We must answer, in these same terms. And when we come to the musical performance, what does the musician have to do? He has to control pitch, loudness, time and timbre. This conception does not oversimplify; because it leaves room for all kinds and degrees of complexity. Rhythm is primarily a periodic pulsation in time and loudness, but it carries meaning and this meaning lies in a rich infiltration with higher cognitive emotional and motor factors, but all these are integrated in a hierarchy of manifestations of the basic concepts. The same is true in principle of volume, harmony and tone quality. Musical emotion, in so far as it arises from the musical stimulus or the response, as in musical phrasing, is subject to interpretation on the same principle.

These processes of simplifying the psychological approach to music are all essential to the scientific effort in analyzing, measuring and evaluating musical talent. We are no longer confronted with the question whether the child is musical or unmusical, but rather with such specific, answerable questions as: To what degree does this child have a sense of pitch, a sense of loudness, sense of time, sense of rhythm, sense of timbre, sense of volume, sense of harmony, sense of tone quality? Each of these it is possible to isolate, to measure and to evaluate in relation to the total profile obtainable through these and numerous other measure-

ments. Thus, vocational guidance was given a sound basis.

V. Norms of Artistic Performance, Actual or Ideal

With the progress thus made, it has been possible to establish norms of musical capacity and norms of musical performance. Under various conditions it has been possible to show the normal mode of attack in the intonation as exhibited by the best singers of to-day, and state quantitatively in the pattern score the degree and character of its variations. The same has been done for the sustaining of tone, the release and portamento, so that in picking up a new specimen of vocal intonation, we can immediately compare it with established norms. This procedure of establishing norms can be continued indefinitely, thus setting up standards of performance in any aspect of music. The musical critic may be able to speak in concrete terms of the characteristics of the performance of a singer or violinist in relation to established norms.

But in so far as psychology of music is an applied normative science, it is not satisfied with what is, but continually raises the question, What ought to be? This question is, of course, of profound significance for the art. Take the case of that pulsating, tender quality of music which we call the vibrato. Adequate norms for reporting the scores of the best singers of to-day show that the average extent of the pulsation is a little over a semi-tone. This seems unbelievable; but it is possible and tolerable because we do not hear the pulsation as it actually is; we hear it as only a small fraction of that extent. It is modified by certain laws of illusion; but even then psychologists have come to the conclusion that what we have now is not the best possible. So by elaborate experiments it has been determined that the vibrato of the singer should be greatly reduced and that the ideal norm for musical ears would come nearer to a quarter-tone than a half-tone of pulsation. That is establishing an ideal norm with numerous concrete specifications for its variability.

In the same connection, elaborate experiments have been made to determine by what method of instruction and training this refinement can be made, and it has been found that it can be made quite rapidly and with a high degree of precision by an expert. How much would such a change in the singing profession be worth in terms of cost of musical education? How much would be the substitution of the ideal for the actual norm worth in the development of higher art principles?

Another phase of the psychology of learning which has come out of the laboratory situation is the art of developing particular musical skills. This art may be expressed in two propositions: in acquiring musical skill, isolate and master one factor at a time until it becomes habitual and automatic; and, in the actual musical performance, act in the musical mood without consciousness or deliberation about each of the scores of musical skills which have been made automatic. For this purpose instruments have been devised to facilitate musical training so that when a student is learning to sing or play intervals in accurate intonation, he sings or plays in front of an instrument which shows to the eye instantly whether or not he is right or, if he is wrong, to what extent he is wrong. Thus, training the ear by the eye vastly shortens the training period and makes possible a much higher degree of precision.

Thus, we have traversed steps in the evolution of an applied science, showing the possibility of establishing law and order in music as a work of art, of gathering and organizing facts from underlying sciences so as to be of trustworthy value in the evaluation of a particular bit of music as a work of art, of guiding and evaluating talent, of establishing principles of musical training and of setting up new goals for attainment within the art.

Much of the achievements in these respects constitutes a contribution to pure psychology, and in turn it will be safely said that achievement in this field is contingent not so much upon specific orientation in the psychology of music as such, but rather upon a general power and mastery of pure psychology based upon experiment. Without experiment, there can be no science, and without pure science, applied science could not get far.

VI. The Science of Fine Arts

The development in the science of music has been fertile in its contribution toward a scientific approach to the other fine arts. Dramatic speech and poetry are notable examples. The same instruments which are used in measuring music can be used in measuring speech, as in the reading of poetry or in acting. Many of the same criteria of scientific procedure apply. Many of the vantage grounds obtained in one art relate to another. Poetics, for example, which is a highly developed discipline in literature, has been approached with distinguished success by the same techniques, instruments and point of view as have been developed in music. The psychology of the graphic and plastic arts transfers in large part from the psychology of music. The result of this tendency is that there is a rapidly forming general science of the fine arts.

VII. Esthetics

I must mention one other vantage ground; namely, the gaining of a sound footing in the laying of foundations for a scientific musical esthetics. The scientific

approach having been made available, current theories of esthetics must be submitted to a rigid re-examination to determine the degree of their validity. Many of the theories of esthetics now current in the books will be swept away under the acid test, and in place of these there will gradually begin to accumulate new concepts, new organizations, new foundations for a scientific philosophy of the beautiful in music.

The above has been an interpretation in high relief, ignoring manifest limitations, qualifications, difficulties and discouragements, of which there are many. Instead of representing the view from peaks of success, I might well have prowled through the shadows and slues of despondency, calling attention to the limitless scope of the undertaking, the dangers involved, the heroic courage required in overcoming difficulties. All these phenomena in low relief are very real and abundant, but it has been my object and pleasure to limit myself to the pointing out of the vision gained from successive new vantage grounds in the infant science of acoustics and its subsidiary, the applied psychology of music.

THE EFFECTS OF AMERICAN ENVIRONMENT ON IMMIGRANTS AND THEIR DESCENDANTS

By Professor FRANZ BOAS
COLUMBIA UNIVERSITY

THE problem of the assimilation of alien populations transplanted into a new cultural medium in which they form a minority has given rise to much public discussion. Few attempts have been made to obtain verifiable data. The problem involves the answer to two questions. Knowing the importance of heredity in determining bodily form and function we have to understand the composition of the immigrant and native populations and their biological differences. Furthermore, we must try to differentiate sharply between what is hereditarily and what environmentally determined. In other words, we have to inquire whether and to what extent bodily form and function are constant or changing in different kinds of environment.

A study of this kind must necessarily cover a sufficiently long period during which assimilation may have been going on and requires, therefore, a long period of observations. I will try to sum up briefly the results of studies extending over a period of twenty-seven years.

The comparative study of alien and native populations had to be based on the degree of variability of each population; in other words, on the multiplicity of forms of the component individuals. We have known for many years that this variability is much greater in man than in pure-bred domesticated animals. This is due to the very slight amount of selective mating of man. We have also been able to show that in some zones in which different types came into contact the variability in regard to certain bodily features increases. Thus the variability of types in Italy is greatest in Central Italy, where the North Italians and South Italians who are very different in physical build mingle. This, however, is not true of all bodily features, some of which are quite uniform in mixed populations. On the basis of such observations it has been found by many observers that every large population is of very mixed origin, so much so that in Europe it is hardly possible to assign any individual with certainty to a particular part of the continent, because the variations in every type overlap. I have tried the experiment of identification in colleges. The new students who did not know one another were asked to designate the descent of their new fellow students. The most contradictory answers were received. Not only was it found impossible to distinguish between North European individuals, but Italians, North Europeans and Jews were misplaced in as many as 40 per cent. of the cases.

The variation of forms of individuals does not give a sufficiently clear picture of the genetic constituents of a population because we do not know how much may be due to outer conditions, how much to the presence of distinct genetic lines. The existence of diverse genetic lines is clearly proved by family resemblances between parents and children and between brothers and sisters. It is necessary to determine the degree of genetic complexity in a population. Obviously, if all families were genetically alike and uninfluenced by outer circumstances, there would be no family resemblances, because for any one member of a family, one of another family might be substituted. In a closely inbred population something of that kind might be expected, but no case is known in which an identity of family lines, such as is nearly attained in pure breeds of domesticated animals, is found. On small islands with inbred populations, among the isolated mountaineers of Kentucky and in other inbred communities a considerable diversity of family lines remains, and in the large areas of so-called uniform racial types great differences in bodily form of distinct

families are found. This quite agrees with our everyday observation of individuality of bodily forms in families in any one of our modern populations. The more precise, therefore, the anatomical description of what is to be called a race, the more diverse types will be represented in every population.

It is not by any means obvious that all these differences must necessarily be due to mixture, for the genetic character of each pair of individuals is such that it is capable of giving rise to forms that are not genetically identical. Still, there is no doubt that most of the great variability of each local type is due to intermingling of distinct local strains. This is evidenced by our historical knowledge of migrations, not only in Europe, where one wave of migrating peoples followed another, but in all parts of the world; in Africa, primitive America and Asia. Mankind has been on the move for thousands of years.

Populations have moved from one climate to another, and distinct cultures have been thrown together. The question arises whether such changes bring about any modification of bodily build and with that, perhaps, of bodily function. This question can nowhere be better studied than in the United States with its great influx of immigrants from all parts of the world. It has been known for a long time that the bulk of the body as expressed by stature and weight is easily modified by more or less favorable conditions of life. In Europe there has been a gradual increase of bulk of body between 1850 and 1914. Adult immigrants who came to America from South and East Europe have not taken part in this general increase. They have, so far as we can see, always kept on the same level, presumably because they were always selected from a body the social condition of which has not materially changed. Their children, however, born in America, or who came here young, have participated in the general increase of stature of our native population. With this go hand in hand appreciable differences in bodily form. Just in the same way as the proportions of body, head and face of animals born in captivity change when compared with their wild-born ancestors, thus the bodily proportions of man undergo minute changes in new environment. In some types the forms of head and face of immigrants are wider than those of their children. Dr. Shapiro has reported corresponding changes among descendants of Japanese born in Hawaii.

These changes do not obliterate differences between genetic types, but they show that the type as we see it contains elements that are not genetic but an expression of the influence of environment.

Physiological functions are naturally much more subject to environmental influences because they are in each individual modified in accordance with momentary conditions of life. Metabolism, heart rate, breathing all depend upon the momentary demands made upon the body and, therefore, also upon the general mode of life, thus overlaying the purely biologically determined function.

The rate of individual development offers an excellent method of studying the relative importance of the influence of environment and of genetic makeup. As an example we may follow the onset of puberty in different areas and different social groups. In New York the time of the onset of puberty is very much alike among Whites of most varied descent and among Negroes. There is a fairly considerable retardation among poor Negroes, which would presumably also be found among poor Whites. Contrary to current opinion, climate does not seem to have much to do with it, for West Indian Negroes and Southern Negroes mature considerably later than those in New York City, which agrees with the observation made in Europe that rural populations mature later than those of cities. It is, however, noticeable that the course of attaining maturity is slightly different in the Negro race as compared to the Whites, in so far as the process seems to be more energetic. Such differences, possibly of a hereditary character, may also be observed in the eruption of teeth among South African Negroes, whose permanent incisors develop later than those of white children, while the molars develop earlier. Racial differences that have been observed are always of such a character that on account of individual variability and the slight amount of average differences many individuals have similar or identical rates of development. Still, it is possible to prove that hereditary elements are involved in the tempo of development; for statistically the tempo of development of a group of brothers and sisters is so related, that if one of them develops quickly, the rest will also develop quickly. This has been proved for a large group of children living in the same institution, and therefore under the same outer conditions. Here, as in other cases, we should not forget that this is a familial, not a racial relation. There are sufficient evidences that the same familial, genetic relation determines the life span. This is indicated by the study of familial longevity, and better founded on Professor Bernstein's observations on the relation between the onset of presbyopia and length of life. According to his observations senile decay sets in early in those cases in which presbyopia develops at an early age. I believe this he has also proved to be of familial trait.

So far I have discussed anatomical and physiological data which prove that the human organism while genetically determined is modified by outer influences and that in man we must keep clearly apart familial heredity and race. On account of the great variety of

genetic lines contained in every population we can not speak of racial heredity except in a very restricted sense, namely, when we discuss traits that are common to every member of a population contrasted with others that lack this trait or have others in its stead.

From a sociological point the problem of hereditary determination of personality is much more important. Unfortunately no method has so far been devised that could give us a clear picture of a personality as biologically determined. The observation of pathological cases proves definitely that such a relation exists, but the individual is so much influenced by the experience of life, and the conditions under which his personality manifests itself are so elusive that, at the present at least, the attempt to describe the personalities composing a population, much less that of differentiating between hereditarily and environmentally determined elements, seems hopeless. Recently much stress has been laid on the observation of the behavior of identical twins, that of individuals genetically identical. It is true enough that biologically they are much alike, and it may be that for this reason they may respond, other things being equal, in similar ways to cultural stimuli. Much has been made of a few scattered observations of this kind, the validity of which is made very doubtful by L. J. Bossik's study of 130 pairs of identical[1] twins, for whose physiological behavior he finds a considerable amount of non-genetic environmental influence. It may be admitted that there is a greater likelihood that identical twins, or for that matter brothers and sisters, will react in ways more similar than individuals not genetically related, but this does not imply that identical twins exposed to different types of culture will not develop different personalities. Furthermore, it must not be forgotten that pairs of identical twins in a population represent very different genetic lines.

On account of these difficulties it seems best to attack the general problem in another way. If it is true that behavior is genetically determined, then it must express itself in very definite ways in fundamental traits. One of these that seems most closely tied up with the biological make-up of the body is found in the motor habits of people. Ethnological data prove that motor habits over wide areas are very uniform. Thus the modern American Indian cuts by drawing the knife towards his own body, the African or the American whittler cuts away from his body. The handles of implements stored in our museums are expressions of the motor habits of people. It seemed, therefore, possible to investigate the motor habits of various groups.[2] These are found expressed most clearly in their postures and gesticulations, and two groups were selected known for lively gesticulation and characteristic postures. The problem was first to establish their characteristics and, second, to investigate in how far these are changed in American environment. First of all it may be well to show that the common assumption that Americans do not gesticulate is not correct. Even aside from the well-known oratorical gestures we are fairly lively. Most of our gestures may be designated as descriptive. We supplement our speech with movements that indicate the form of what we are talking about. Nevertheless, on the whole our gestures are moderate as compared to those of Italians. Let me indicate how we investigated the character of the gestures. A moving picture giving posture in intervals of 1/16 of a second was projected frame by frame on a screen and the movements of arms and head were marked on a diagram so that the movement could be analyzed in detail. Italian gestures are characterized by a wide symmetrical sweep from the shoulders. Furthermore, they are symbolic. The gestures have definite meanings, many of which may be traced back to antiquity. "It is good," "I am hungry," "prison," are presented by definite symbols. For this reason Italians are able to converse in pantomime without uttering a single word. Their posture is characterized by an easy relaxation of the shoulders and a strong forward curvature of the lumbar region. At the same time the elbows are held backward, and there is a preference for holding the wrist of one hand with the other, both being held in the back. By contrast the Jewish gestures are jerky. The wide sweep of the Italian is absent. Generally the two hands do not move symmetrically. The elbows are almost stationary, close to the body, and the movements are made with forearm and fingers. They are emphasized by movements of the head. They are not graphic, but follow lines of thought. Since very few of their gestures are symbolic, pantomimic conversation without words is impossible. By contrast with the Italian the Jew tries to get in touch with his friend. He will even grasp his hand and gesticulate with his hand. The posture is characterized by a slump of the neck and relaxation of the knees.

These are the traits of the immigrant who has grown up entirely in the old environment. Their descendants, who have left the Italian or Jewish quarter and live in an American environment, change their habits completely. Naturally it depends upon the degree of their separation from the old environment. This is shown clearly by the contrast between the postures of students in an orthodox Jewish seminary and those of the same age in an advanced school attended largely by Jewish students. Conversely, we have observed how Englishmen who live in an Italian or Jewish environment

[1] Proceedings of the Maxim Gorky Medico-Biological Research Institute, Moscow, Vol. III, 1934, pp. 33–56.

[2] This work was carried through by Dr. D. Efron, Mr. Stuyvesant van Veen and Dr. J. P. Foley.

adopt their motor habits. We have one example of an Englishman raised in Italy and married to a Jewess, who has adopted the mixed quality of Italian and Jewish movements. It is also notable that occupations influence gesture habits. Thus many painters accompany their speech by movements which imitate the motions of the brush in painting. How little stable motor habits are may also be observed in a comparison of the modern repression of gestures in England which seems to have begun shortly before the Victorian era in contrast with the lack of restraint in Elizabethan times.

The problem of the adjustability of behavior may also be established on entirely different lines. We have studied the incidence of psychoses in immigrants and their descendants.[3] Owing to the varying age distribution of the incidence of mental diseases, the data which are commonly used are entirely misleading. Mental disturbances among the young are very rare. Since the native population embraces a large number of children, the immigrants comparatively few, the incidence appears much smaller among the former. It is necessary to know for each psychosis the age distribution of its incidence and to reduce the crude figures accordingly. By doing so it can be shown that there are considerable differences between the two generations. We have carried through this study for Italians, Irish and Germans. It will be seen that, rather unexpectedly, we find a considerable reduction in most cases in the second generation and on the whole an approach to the general American standard. The Irish have a number of peculiarities that deserve special study. The importance of considering the age distribution has been pointed out years ago by Dr. Landman and has been worked out more accurately by Dr. Malzberg. It is worth remarking that the complete exclusion of imbeciles among the immigrants does not seem to have affected the incidence of imbecility among their descendants, although, on account of the lack of a strict definition of imbecility it is difficult to give numerical proof. The number, however, is large and shows how little effect exclusion of an affected group, either by immigration laws or by sterilization, has upon the incidence of partly hereditary diseases.

It seems that these various approaches to the problem show first of all that no race can be treated as a unit, but that in every case the individual must be evaluated according to his own characteristics. It follows, furthermore, that at least so far as the aspects studied are concerned, the descent of the individual plays an insignificant rôle in his behavior, that the organism is so plastic that in its physiological, mental and social behavior it follows the pattern of culture with which he becomes identified.

[3] This work was carried out by Dr. Bruno Klopfer.

OBITUARY

ALFRED McLAREN WHITE

THE North Carolina section of the American Chemical Society adopted on September 25 a minute in memory of Dr. Alfred McLaren White. The minute, drawn up by Edward Mack, Jr., *chairman,* F. H. Edmister and E. C. Markham, reads:

On Wednesday morning, September 23, 1936, in the Presbyterian Hospital in New York City, Alfred McLaren White died of acute nephritis. Dr. White was born at Ann Arbor, Michigan, on July 1, 1904. He received the B.S. degree from Michigan in 1925, the M.S. degree from the University of California in 1926 and the Sc.D. from the University of Michigan in 1928. He served as assistant professor of chemical engineering at the Georgia Institute of Technology from 1928 to 1930. In the fall of 1930 Dr. White came to the University of North Carolina as associate professor of chemical engineering, and when this was made a separate division, he became the director. Under the inspirational teaching and guidance of Dr. White, the enrolment of the chemical engineering department increased about fourfold over a period of five years. Always popular with his students, both in the classroom and outside, his interest in them was manifested by his enthusiastic teaching and his participation in numerous student activities. This September he was to take up his duties as director of the chemical engineering work in the University of Virginia.

Dr. White was an associate member of the American Institute of Chemical Engineers, a member of the American Chemical Society, Sigma Xi and the Elisha Mitchell Scientific Society.

McLaren White was known to many people outside the chemical profession for his versatility and accomplishments. He spent a part of several summer vacations in the Artist Colony on Monhegan Island, and a number of his friends have visible evidence of his ability as an amateur artist. He was also a musician. During his stay in Chapel Hill he was an active member of the Choral Club and the University Concert Orchestra.

The untimely death of Dr. White at the virtual beginning of a promising scientific career is a great loss to both the professions of chemical engineering and chemistry. The North Carolina Section of the American Chemical Society deeply mourns a leader and an ever helpful member. Your committee offers this statement as a resolution to be spread on the minutes of the section, with instructions to the secretary to forward a copy to the family.

ALBERT B. REAGAN

DR. ALBERT B. REAGAN, special professor of anthropology at Brigham Young University, Provo, Utah, died on May 30, following a brief illness.

Born in Maxwell, Iowa, in 1871, Dr. Reagan was graduated from Central State Teachers College, Oklahoma, in 1898, was awarded an A.B. degree at Valparaiso University in 1899, A.B. and M.A. degrees at the University of Indiana in 1903, and, majoring in geology, a Ph.D. degree at Stanford University in 1924.

From 1899 to 1934, Dr. Reagan was connected in various capacities with the field service of the Office of Indian Affairs. During these years he carried on ethnological, archeological and geological research in the Southwestern and Northwestern United States, and, from 1926 to 1934, in the Uintah Basin, Utah, where he was employed on the Ouray Indian Reservation. In 1934, Dr. Reagan was appointed to the faculty of Brigham Young University.

Dr. Reagan carried on extensive research, making many important contributions to geology and anthropology. His scientific papers, which number more than 500, were published in numerous scientific journals in the United States and other countries. During his last few years, Dr. Reagan's most important field of research was the archeology of the Pueblo-Basket Maker cultures of northeastern Utah.

J. H. S.

RECENT DEATHS

DR. A. B. CORDLEY, dean emeritus of the School of Agriculture at the Oregon State College, died on November 1 at the age of seventy-two years.

RICHARD CARMICHAEL HOLLYDAY, who retired thirteen years ago as chief of civil engineers for the navy with the rank of captain, died on November 18 at the age of seventy-seven years.

DR. HERBERT NICHOLS, at one time instructor in psychology at Harvard University, died on December 6 at the age of eighty-four years.

DR. FLORENCE RICHARDSON ROBINSON, formerly professor of psychology at Drake University and assistant professor of psychology at the University of Chicago, died on December 4 at the age of fifty-one years. Dr. Robinson was the wife of Dr. Edward S. Robinson, professor of psychology at Yale University.

SCIENTIFIC EVENTS

THE ROCKEFELLER FOUNDATION AND THE KAISER WILHELM INSTITUTE

The New York Times reports that the Rockefeller Foundation has granted $655,000 to the Kaiser Wilhelm Institute of Germany in fulfilment of pledges made before the Hitler régime came into power.

The grant has been used to establish research laboratories for the study of cellular physiology and for research in pure physics. Dr. Peter Debye, of Holland, who recently received a Nobel prize, is head of the Institute for Physics, which is expected to open within a few weeks.

According to *The Times,* Dr. Raymond B. Fosdick, president of the Rockefeller Foundation, called attention to the fact that in making the money available the foundation was carrying out promises made to the Kaiser Wilhelm Institute prior to 1930. Dr. Fosdick is reported to have said: "The world of science is a world without flags or frontiers. It is quite possible, however, that the foundation would not have made the grant if it could have foreseen present conditions in Germany."

The grant was made by the foundation under direction of its Division of Natural Sciences. Before the Hitler administration assumed power the Kaiser Wilhelm Institute approached the Rockefeller Foundation to obtain the desired allotment of funds. The foundation agreed to provide the money for the ground and buildings for the two laboratories and for part of the equipment. The Kaiser Wilhelm Institute was to provide for continuous upkeep, the salaries of personnel and the rest of the laboratory equipment.

Ground for both establishments was purchased at Berlin-Dahlem, a suburb of the capital. The laboratory for the institute of cellular physiology was completed in 1931, and Dr. Otto Warburg, also a Nobel laureate, was appointed director.

A delay in beginning work on the physics laboratory was caused by the inability of the Kaiser Wilhelm Institute to find a physicist who could meet the requirements laid down by the Rockefeller Foundation. Dr. Debye was persuaded to leave his post at the University of Leipzig to become director of the institute.

In the early negotiations between the Rockefeller Foundation and the institute the German Government did not take part. However, after the Hitler government assumed control the German Finance Minister was a party to the discussions. The final payments of the fund were made in May, 1935, after the Minister of Finance had pledged the German Government to the fulfilment of the parts of the agreement for which the institute was responsible.

Several distinguished scientific men have been dropped from the Kaiser Wilhelm Institute since the ascendancy of the Nazi government. Among them were the late Fritz Haber, head of the institute of

electro-chemistry, and Dr. Richard Goldschmidt, who is now professor of zoology at the University of California.

A FRAUDULENT ACADEMY OF SCIENCES

THE following communication, signed by Dr. Stephen Duggan, director of the Institute of International Education, appears in SCHOOL AND SOCIETY for last Saturday:

A letter signed by Professor Arsenio des Santos Barboza, secretary director of the Academia de Sciencias e Artes at Rio de Janeiro, has been sent to a number of scientific men and scholars in the United States inviting them to become members of the society. The letter addressed to a chemist follows:

As homage to your great technical merits and in gratitude to the services you have contributed to teaching in America, the Congregation of this Academy resolved to confere you a Diploma of Doctor in Chemistry, in *Honoris-Causa.*

We know that the United States is to-day the world's largest producer of chemical commodities and without boasting, the United States now can lay claim to a greater chemical industry than that possessed by any other country. I would be very happy to see you among us and I would also appreciated picture of yourself.

This Directions has confirmed this acts of high justice and has confered you the Gold Medal of Merit.

Any further reply you may care to send, it will be warmly appreciated and I want to thank you for the kind attention given to this letter.

The communication given below was enclosed in the letter.

Just a few lines to let you know that the cost of graduation with a Diploma, credential and the Gold Medal of Merit is $10.00 (ten dollars) minimum.

If you can to send some donatif and books written by you for the patrimony of this academy have the kindness to satisfy, I will be very thankful.

No Bill payable on order: SEND AMERICAN BANK NOTES, BY RETURN OF POST.

ANNUAL REPORT OF THE CHIEF OF THE WEATHER BUREAU

DR. W. R. GREGG, chief of the Weather Bureau, in his annual report for the year ending June 30, points out that an unusually cold winter over most of the country, followed by unprecedented floods in the East, severe drought between the Appalachian and Rocky Mountains, bad dust storms in the Midwest, and destructive tornadoes in the Southeast, brought heavy demands for extra service to the U. S. Weather Bureau. These demands were met with special surveys, forecasts and warnings. The hurricane warning system along the South Atlantic and Gulf coasts was strengthened and the meteorological service for airways was somewhat expanded. At the same time further research work was planned to "enable it to contribute its full share to the development of the nation's economic and social life."

Despite its restricted facilities, the Weather Bureau advanced its air-mass analysis investigations and the application of the results to daily forecasting. In response to public demand, it is studying and appraising the possibilities of all known methods of long-range forecasting. Without a knowledge of general weather trends that have existed over a great many years, Mr. Gregg explains, it is impossible to draw a pattern that will show the forecaster what may be expected within a month, a week, or even a few days. To this end, weather conditions in the United States and in foreign countries have been surveyed in an attempt to discover relationships between the weather abroad and that at home.

The increasing need for accurate information on conditions in the upper air has inspired the invention of several recording instruments. Those showing most promise of being immediately available are one for getting to the ground radio signals of temperature, humidity and pressure; one for finding and indicating the position of the abnormally warm layer of air several thousand feet above the earth that precedes by several hours the formation of fog; and a better ceiling light projector for ascertaining the height of a cloud layer. Further tests are necessary, however, to prove the trustworthiness of these devices.

The compilation and summarizing of more than 5,000,000 marine weather observations made in all parts of the oceans from 1880 to 1933, and never worked up before because of lack of tabulators, went forward this year as a WPA project. The information obtained will be valuable to navigators of the seas and of the air. It will serve also as the basis for studies of world weather in connection with crop weather and with weather preceding floods. This, in turn, will aid the bureau in improving its forecasts for farmers and its flood warning service.

Of interest to mariners also is the study of mirage at sea, completed this year. The findings—to be printed in the Pilot Charts of the Hydrographic Office—show that refraction phenomena occur not only in local regions where the atmosphere is undisturbed, but over larger areas along the boundary lines of oceanic cyclones and anticyclones. They show further that atmospheric conditions producing fog may produce mirage as well.

THE SUMATRA EXPEDITION OF THE NATIONAL GEOGRAPHIC SOCIETY AND THE SMITHSONIAN INSTITUTION

AN expedition, under the joint auspices of the National Geographic Society and the Smithsonian Institution, to the jungles of Sumatra, to collect alive wild animals of the Far East for the National Zoological Park in Washington and to a make a collection of geo-

graphic and natural history information and photographs, has been announced by Dr. Gilbert Grosvenor, president of the society. Dr. William M. Mann, director of the National Zoological Park, is head of the expedition.

Accompanying Dr. Mann will be Mrs. Mann, a member of the photographic staff of the National Geographic Society, and Roy Jenier and Malcolm Davis, of the park staff. The party will sail from Seattle and, after brief pauses in Japan, the Philippines and Singapore, will establish headquarters at some point on the Island of Sumatra, near the sea, and in easy reach of "wild country." Equipment will include a number of special "mercy traps" and a few special cases in which to carry small, delicate creatures. The heavy traps and cages needed for the larger jungle beasts will be built in the field. Dr. Mann states that the region to be visited is at present only poorly represented by animals in the National Zoological Park. He will confer with game officials and naturalists in the countries to be visited, and will collect whatever he can of the missing specimens. Mammals, reptiles, birds and a few fishes will be the primary objects of the collectors, but in spare time insects and a few botanical specimens will be collected.

The trip to the East Indies under joint Geographic and Smithsonian auspices has been planned for some time. The project was approved and organized with its complete personnel two years ago, but was delayed on account of the extensive building program at the Zoological Park, which has since held Dr. Mann in Washington.

After the work is completed in Sumatra, the expedition expects to visit the Island of Ceram, almost 2,000 miles to the east, and possibly some of the East Indies islands not under Netherlands jurisdiction. Before starting home, the party will also visit Bangkok, Siam. It will return through the Indian Ocean and the Mediterranean to England. There the collections will be shipped to America. If possible, it will be arranged to land at Baltimore in order to shorten the overland trip.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

AT the annual meeting of the American Society of Mechanical Engineers, which opened on December 1, the Hoover Medal was presented to Ambrose Swasey, of Cleveland, by Gano Dunn, of New York. Mr. Herbert Hoover spoke briefly after the presentation.

Other awards were made as follows:

An honorary membership to George A. Orrok "for his outstanding contributions to the engineering profession in the power field."

The American Society of Mechanical Engineers Medal to Edward Bausch, of the Bausch & Lomb Optical Company, Rochester, "for meritorious mechanical developments in the field of optics."

The Worcester Reed Warner Medal to Professor Charles M. Allen, of the Worcester Polytechnic Institute, Worcester, Mass., "for his early and continued hydraulic laboratory work and for the permanent value of the papers on his development of methods of testing large hydraulic turbine installations."

The Melville Medal to H. A. Stevens, of Philadelphia, for his paper on "The Loading and Friction of Thrust and Journal Bearings with Perfect Lubrication."

The Junior Award to Harwood F. Mullikin, Jr., of New York, for his paper on "Evaluation of Effective Radiant Heating Surface and Application of the Stefen-Boltzman Law to Heat Absorption in Boiler Furnaces."

The Undergraduate Student Award to Leon B. Stinson, of the Oklahoma Agricultural and Mechanical College, for his paper on "Polymerized Motor Fuels: Their Economic Significance."

The ninetieth anniversary of the birth of George Westinghouse, inventor of the airbrake and the steam turbine, was observed at the evening session, when the principal address was made by Dr. James Rowland Angell, president of Yale University.

The society elected the following officers for 1937: J. H. Herron, of Cleveland, *president;* J. M. Todd, of New Orleans, and R. J. S. Pigott, of Pittsburgh, *vice-presidents,* and E. W. Burbank, of Dallas, Tex.; K. H. Condit, of New York, and Dean S. W. Dudley, of the Yale University School of Engineering, *managers.*

FIRST ANNUAL SYMPOSIUM OF THE DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY OF THE AMERICAN CHEMICAL SOCIETY

THE symposium is to be held at Princeton University on December 31 and January 1 and 2 on the general topic "Molecular Structure." The program, which includes contributions both from chemists and physicists active in the several branches of this field, is outlined below.

The program will be divided into half days as follows:

Thursday morning, December 31. General introduction to the symposium, H. L. Johnston, the Ohio State University. Five papers on "Spectra and Structure of Diatomic Molecules" and other topics, with R. S. Mulliken as discussion leader.

Thursday afternoon and Friday morning. There will be ten papers on "Spectra and Structure of Polyatomic Molecules," with W. A. Noyes, Jr., as discussion leader.

Friday afternoon. Five papers will be given on "Determinations of Structure by Methods which are Non-Spectroscopic," with G. B. Kistiakowsky as discussion leader.

Saturday morning will be devoted to "Some Applications of Knowledge of Structure," with Saul Dushman as discussion leader.

There will be twenty-seven papers on these five half-days, but since preprints are to be made available in advance of the meeting, the time required for presentation is expected to be small and the discussion will be allowed to take most of the time. Contributions to the discussion should be sent (in advance of the meeting, if possible) to Dr. W. A. Noyes, Jr., Brown University, Providence, R. I.

Only contributions received before January 10, 1937, can be considered for publication with the discussion. Such comments will be subject to editorial control and revision and probably space limitations will prevent the publication of the entire discussion.

On Saturday afternoon a session will be devoted to papers which were completed too late for inclusion among the preprints. The details of this session as well as the complete program of the other papers will appear in the News Edition of *Industrial and Engineering Chemistry*.

Preprints may be ordered from the Secretary of the Division of Physical and Inorganic Chemistry, Professor George Scatchard, Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Mass. The price will be one dollar (except to the members of the division, who may order one copy each at the special rate of fifty cents).

Those planning to attend the symposium should make their own arrangements for hotel accommodations. Thirty rooms are available at the Graduate College at two dollars a night and reservations may be made through E. A. Smith, Graduate College, Princeton University, Princeton, N. J.

The registration fee will be fifty cents except to American chemists who are not members of the American Chemical Society, for whom the registration fee will be one dollar. The registration fee may be paid to the secretary of the division, Professor Scatchard, in advance of the symposium. In order that the committee may form an estimate of the probable attendance a pre-payment of this registration fee would be appreciated by members of the committee.

The arrangements for the symposium have been under the direction of a committee consisting of H. L. Johnston, *chairman,* Farrington Daniels, Saul Dushman, W. M. Latimer, W. A. Noyes, Jr., H. S. Taylor, H. H. Willard and H. C. Urey, with John Turkevich, Princeton University, as local representative.

THE AMERICAN SCIENCE TEACHERS' ASSOCIATION

THE tentative program for the meeting of the American Science Teachers' Association, affiliated with the American Association for the Advancement of Science, on December 31 at Atlantic City is as follows:

MORNING

"Composition of the Upper Atmosphere." Speaker: W. J. Humphreys, U. S. Weather Bureau.

"The Relative Claims of Natural Science and of Social Studies to a Core Place in the Secondary School Curriculum." Speakers: for natural science—Dr. Oscar Riddle, Carnegie Institution of Washington; for social studies—Dr. Roy W. Hatch, Montclair State Teachers College.

Discussion by leaders and from the floor.

LUNCHEON

Speaker: Dr. Edwin G. Conklin, president of the American Association for the Advancement of Science.

AFTERNOON

"The Next Ten Years in Science Education." Speaker: Dr. Otis W. Caldwell.

Discussion by leaders and from the floor.

"The Need for a National Publication for Science Teachers." Speaker: Professor Earl R. Glenn, Montclair State Teachers College.

Discussion by leaders and from the floor.

"Theories of Solar System Origin." Speaker: ———.

Discussion by leaders and from the floor.

or

"Desirable Training for Science Teachers." Speaker: ——— ———.

Discussion by leaders and from the floor.

Business meeting.

SCIENTIFIC NOTES AND NEWS

DR. ALFRED NORTH WHITEHEAD, since 1924 professor of philosophy at Harvard University, who is now seventy-five years old, will retire with the title professor emeritus next September. He will also resign as senior fellow in the Society of Fellows. It is planned that the annual sessions of the American Philosophical Association, which will be held in Cambridge on December 28, 29 and 30, be in his honor.

PROFESSOR LEO LOEB will retire from the chair of pathology and as head of the department at the Washington University School of Medicine on January 1.

DR. WILLIAM T. HORNADAY, who was for thirty years director of the New York Zoological Society, celebrated his eighty-second birthday on December 1.

THE honorary doctorate of science was conferred by Alfred University on Founders' Day, December 3, on Professor Alexander Silverman, head of the department of chemistry of the University of Pittsburgh, who

delivered the Founders' Day address. He spoke on "A Better World through Science."

THE degree of doctor *honoris causa* was conferred on Professor George David Birkhoff, professor of mathematics at Harvard University, by the University of Paris, and on Dr. Israel Holmgren, professor of physiology at the Caroline Institute of Stockholm, on November 1, in the presence of M. Albert Lebrun, president of the French Republic, the Minister of Education and the Rector of the university.

AT the Cincinnati meeting of the Radiological Society of North America, gold medal achievement awards were presented to Dr. Edwin C. Ernst, of the Barnard Free Skin and Cancer Hospital and the De Paul Hospital of St. Louis, in recognition of his "work as collaborator and as an organizer in obtaining world-wide acceptance of the Roentgen unit as the standard of ray measurement and application," and on Dr. Otto Glasser, director of the department of radiation research of the Cleveland Clinic Foundation, in recognition of "the development of the ionization chamber and an instrument for measurement of x-rays in terms of 'Roentgen units.'"

THE medal of the Technical Association of the Pulp and Paper Industry for 1937 has been awarded to Dr. Clarence J. West, editor of *Institute of Paper Chemistry,* formerly director of the department of research information of the National Research Council. The presentation will be made in February at the annual meeting of the association.

DR. JAMES T. NIX, of New Orleans, has been appointed director of the Louisiana State University Graduate School of Medicine.

DR. H. P. COOPER, head of the department of agronomy at Clemson College, S. C., was recently appointed director of the Agricultural Experiment Station.

DR. MORRIS S. KHARASCH, of the University of Chicago, has been appointed Carl William Eisendrath professor of chemistry. Dr. Kharasch succeeds Professor William D. Harkins, who has been named Andrew McLeish distinguished service professor.

THE REVEREND JAMES CASTIELLO, S.J., of Fordham University, has been appointed acting director of the department of psychology of St. Louis University, succeeding the Rev. Raphael C. McCarthy, who recently became president of Marquette University.

DR. DONALD H. CHAPMAN has been promoted to an assistant professorship in the department of geology at the University of New Hampshire and has been given charge of the work in geography and meteorology.

WILLIAM J. TALBOT, formerly Commonwealth fellow at the University of California, has been appointed head of the department of geography recently established in the University of Cape Town, South Africa. Mr. Talbot, who before going to California was associated with the department of geography in the University of Glasgow, has been carrying on research work in South Africa since 1931.

DR. ROBERT B. GREENOUGH, president of the American Society for the Control of Cancer, consulting surgeon to the Collis P. Huntington Memorial Hospital, a member of the Harvard Cancer Commission, has been elected to the board of managers of Memorial Hospital for the treatment of cancer and allied diseases, New York City.

THE Academy of Medicine, of Washington, D. C., plans an extended study of the medical aspects of the interaction between man and his environment. On December 8 the academy met for discussion of "The Reaction of the Individual to His Social Environment, with Special Reference to Emotions as a Factor in Disease." The committee in charge of this phase of the subject consists of Dr. Walter L. Treadway, assistant surgeon-general in charge of mental hygiene, and Dr. Henry H. Hazen, consulting dermatologist, both of the U. S. Public Health Service; Dr. Lewis C. Ecker, associate professor of medicine, Georgetown University Medical School; Dr. Earl B. McKinley, dean, George Washington University School of Medicine, and, from the same institution, Dr. Walter A. Bloedorn, professor of medicine; Dr. William J. Mallory, professor of medicine, and Dr. Vincent du Vigneaud, professor of biochemistry.

A SCIENTIFIC advisory committee of Western Pennsylvania has been formed to advise students in chemical engineering at the University of Pittsburgh. It is planned to make it possible for students to keep in close touch with the chemical engineering industries in the district. Members of the advisory committee will serve as consultants. The committee includes: Dr. F. W. Adams, Mellon Institute; Dr. Eugene Ayers, chief of the division of chemical research, Gulf Research Laboratory, Harmarville; Dr. F. C. Frary, director of research, Aluminum Company of America, New Kensington; Dr. E. E. Marbaker, president of the Pittsburgh section, American Institute of Chemical Engineers; Dr. H. K. Work, director of research, Jones and Laughlin Steel Corporation; Allen D. MacLean, chief engineer, Pittsburgh Equitable Meter Company, and Fred Dening, vice-president, Koppers Research Company.

PROFESSOR ACHARD, member of the Institute of France and general secretary of the Academy of Medicine, has undertaken a mission to Western French

Africa, to study the sanitary reorganization of the colony.

DR. SVEN HÖRSTADIUS, professor of embryology, Stockholm, Sweden, is visiting the United States.

DR. FREDERICK TILNEY, professor of neurology and director of the Neurological Institute of Columbia University, gave an illustrated lecture before the Neurological Study Unit of the Yale University School of Medicine on November 10. He spoke on "The Glands of the Brain with Special Reference to the Pituitary."

DR. S. WALTER RANSON, professor of neurology and director of the Institute of Neurology of Northwestern University Medical School, will deliver the third Harvey Society Lecture at the New York Academy of Medicine on December 17. Dr. Ranson will speak on "Some Functions of the Hypothalamus."

DR. LOYD A. JONES, chief physicist of the Eastman Kodak Company, lectured on December 3 before the Franklin Institute, Philadelphia, on "An Analysis of the Quality of Photographic Pictures."

AT the annual dinner of the Smith-Reed-Russell Society, on November 17, Dr. Charles Franklin Craig, of the School of Medicine of Tulane University, gave the oration, his subject being "Factors Influencing the Transmission of Malaria." Dr. Ernest Muir, secretary-general of the International Leprosy Association, a guest of the Leonard Wood Memorial in the United States, gave the second Smith-Reed-Russell lecture at the School of Medicine of the George Washington University on November 17. He spoke on "The Reaction of the Tissues to the Leprosy Organism."

THE fifty-fifth series of popular medical lectures of the Stanford University School of Medicine, San Francisco, will be given on alternate Friday evenings at 8:00 P.M., during the winter quarter. The lecturers, titles and dates are as follows: Dr. Jacques P. Gray, "Syphilis and Its Control," January 8; Dr. Benjamin W. Black, "The County Hospital and the Public," January 22; Dr. William C. Voorsanger, "Recent Advances in the Treatment of Tuberculosis," February 5; Dr. Frederic C. Bost, "The Crippled Child," February 19; Dr. Sanford M. Moose, "Behind the Scenes of Pain Relievers in Dentistry," March 5; Dr. J. Marion Read, "The Rising Death Rate from Heart Diseases," March 19.

THE annual meeting of the Sigma Xi Club of Southern California was held at Occidental College on the evening of November 19. The address was given by Dr. Paul Popenoe, director of the Institute of Family Relations and secretary of the Human Betterment Foundation, on "The Psychology of Sex Differences." At the business meeting following Roger Truesdale was elected president and J. A. Hartley, secretary-treasurer for the coming year. The retiring officers are H. J. Quayle, president, and H. B. Frost, secretary-treasurer.

THE postponed eleventh International Congress of Psychology will be held at Paris from July 25 to 31. The honorary president will be Professor Pierre Janet. Professor Henri Piéron is president of the organization committee and the general secretary is Professor I. Meyerson. The headquarters of the congress are at the Laboratory of Psychology of the Sorbonne.

THE annual meeting and dinner of the New York Academy of Sciences and affiliated societies will take place on Monday, December 21.

THE two hundred and tenth regular meeting of the American Physical Society will be held at the California Institute of Technology on December 18 and 19. On Saturday morning invited papers on problems related to the telescope project will be presented by Dr. John Strong and Dr. J. A. Anderson, who will also conduct an inspection tour of laboratories and shops engaged in work on the telescope. Dr. Strong will speak on "The Evaporation Process and its Application to Optical Surfaces." Dr. Anderson's title will be "Some Problems Connected with the 200-inch Telescope."

THE *Journal* of the American Medical Association reports that a collection of papers and personal effects of Dr. William Beaumont has been given to the University of Chicago by his grandson, Ethan Allen Beaumont, and his wife, of De Pere, Wis. The collection, consisting of first editions, unpublished letters, a case history, surgical instruments, photographs and a chair presented to the Beaumonts by Robert E. Lee, who once lived with them in St. Louis, was on exhibition at the university library on November 20, together with an oil portrait of Dr. Beaumont lent by A. C. Denny, of Evanston. During the exhibition, addresses were delivered by Dr. Robert Maynard Hutchins, president of the university, and Drs. Anton J. Carlson, Arno B. Luckhardt and Selim W. McArthur. The program, sponsored by the friends of the library of the University of Chicago, was planned to coincide with the one hundred and fifty-first birthday of Dr. Beaumont on November 21.

ACCORDING to *Nature*, C. R. Fairey, past president of the Royal Aeronautical Society, and F. Handley Page, vice-president, have jointly agreed to give £750 a year for seven years to the society. The object of this gift is to enable it to carry out as fully as possible its main object, "the general advancement of aeronautical science and engineering," and to enable it to

be placed on a self-supporting basis. The intention is that the society should become completely independent of donations from outside bodies, so that it may be free to express opinions upon aeronautical research and engineering when necessary, and can encourage the dissemination of papers and information on all matters pertaining to aeronautical research and engineering.

AN industrial fellowship to investigate the durability of automotive tire chains has been founded at Mellon Institute of Industrial Research by the McKay Company of Pittsburgh, Pa., which manufactures commercial chains of all types. The fellowship has for its objective the production of better chains, particularly for the motorist. A comprehensive program of basic research is being carried on, including studies of the design, materials, processes of manufacture and testing of chains. Dr. David F. Helm, research engineer on cast iron metallurgy in the Engineering Experiment Station of the Ohio State University, previously chemist with the Midgley Foundation at Columbus, Ohio, is in charge of the investigation.

A WIRELESS dispatch from Paris to *The New York Times,* dated November 12, states that it is planned to proceed at once with the building of an astronomical observatory on a peak near Forqualquier, in the Basses Alpes, between Avignon and Digne. The atmosphere at that altitude, about 2,000 feet, is said to be especially favorable to astronomical observation. The best available telescopes in France will be installed at once. A contract has been signed for the construction of a two-meter telescope, which will be the second largest after the new telescope in California, and for another telescope, the dimensions and mechanical and optical features of which it is said will make it the most powerful in the world.

THE Crockett scientific expedition, sponsored by the Philadelphia Academy of Natural Sciences, sailed on December 3 aboard the two-masted schooner *Clea* for an eighteen-month voyage among south Pacific islands. The party plans to search the islands for certain specimens of bird and animal life. It also hopes to obtain new information about the geological structure of the islands and the history and habits of the natives.

Museum News reports that plans have been drawn and work begun on the new Fleishacker Zoological Park at San Francisco, which is planned eventually to cover eighty acres. Plans now being carried out provide for the erection of the principal buildings on 40 acres, the remaining 40 acres to be developed later into barless yards and paddocks for antelope, deer and other large hoofed mammals. The largest of the buildings will be the pachyderm house, which will have stalls 30 feet square for elephants, hippopotamuses and rhinoceroses. These stalls will be connected, through sliding doors, with barless outside yards and swimming pools. A feline house for tigers, leopards, pumas, panthers, jaguars and other cats will have on one side, for tigers and lions, four large barless yards bordered with moats 12 feet deep and 20 feet wide; on the opposite side, barred cages for the species that are too agile to be safely exhibited in barless yards. A monkey island, surrounded by a 15-foot moat, will provide quarters for 100 monkeys. Five barless bear dens, now partially constructed, will have open yards surrounded by artificial rock mountains and, in front, a 15-foot moat. Each yard will have a swimming pool in the center. Other structures planned are a flight cage for aquatic birds, a house for finches and song birds, an African veldt with artificial stone walls and moated front, monkey house, reptile house, sheep and ibex mountain and lagoons for sea lions and seals.

DISCUSSION

DO BRAIN WAVES HAVE INDIVIDUALITY?

CAN an individual be identified by his brain potentials? This is an interesting and important point.

Dr. Hallowell Davis, of Harvard, stated at the last meeting of the American Medical Association that the brain potentials of a given individual were distinctive of that individual, and that individuals could be distinguished from each other by their brain potentials. However, he presented no quantitative treatment of records to substantiate this view.

To answer this question, we obtained a fair sampling of brain potentials from 44 healthy university students approximately equally divided in regard to sex. The experimental conditions were kept as constant as possible from subject to subject. The observer reclined on a bed in a dark room. He was instructed to keep his eyes closed and his mind a blank. The brain potentials were led off from the right occipital and the right motor areas. They were recorded by means of standard amplifiers and a Westinghouse oscillograph.

The following procedure was used in identification of individual records. A two-foot strip (matching sample) was cut off from the end of each record. The remainder of the record, which averaged about ten feet in length, was pasted on a wall with the cut-end turned under from 6 to 8 inches. Twenty-two such records were exhibited at one time. Four of us who

had had considerable experience in recording and evaluating brain potentials identified the records. The particular records identified were relatively new to each of us. The one to identify the record was given the matching sample and was instructed to find its mate on the wall. When he had made his decision he was not told whether he was right or wrong. Several days later, each of us repeated the task of matching. This whole process was repeated for the second half of the 44 records so that each one of us identified each record twice.

A total of 352 identifications were made (8×44). By chance, 4.5 per cent. of the records could have been correctly identified. Ninety-four per cent. of the records were correctly identified (20 errors). Seven records were missed by some one of us; one by three of us; and five by two of us. Thirty-one of the 44 records were not missed by any of us.

Some records were identified very easily and quickly. This was so because they had very distinctive characteristics. As may be judged, one or two of the records which were missed by two or three of us were very difficult to identify. This was so because two or three of the records were strikingly similar.

Every one of us became more accurate as we progressed from the first to the fourth trial. Two of us got 91 per cent. right the first time, and 100 per cent. right the fourth time. The other two got 82 per cent. right the first time and 100 per cent. right the fourth time. We are inclined to believe that this indicates learning what characteristic details are distinguishing.

Each of us listed the criteria by which we matched the records. Frequency, amplitude and form of the waves, each played its part. Under form, such characteristics as beta waves, the shape of the alpha waves and the relationship between the negative and positive deflections were noted. Also, we appeared to size up the records as a whole, evaluating such factors as trains, stability of the base line and fluctuations in frequency and amplitude of the waves. Certain other possible cues need to be mentioned. Because of differences in developing the sensitized recording paper from time to time, records differ from each other in regard to color, under- or over-development and accidental exposure to light. Some differences between records were also caused by differences in width of the time line, speed in passage of the paper and wrinkling. One is never certain that he has been able to eliminate such accessory cues, but trials made to see to what extent identification could be carried out by these alone showed them to be as confusing as helpful.

Our conclusion is that human brain potentials have individuality and that an individual can be distinguished from other individuals by his brain potentials. We don't know yet how consistent an individual's brain potentials are from day to day. This is the next question to settle.

LEE EDWARD TRAVIS
ABRAHAM GOTTLOBER

STATE UNIVERSITY OF IOWA

THE USE OF THE TERMS COENOCYTE AND SYNCYTIUM IN BIOLOGY

THE terms coenocyte and syncytium are frequently confused in biological literature. They are always used to describe multinucleate masses of protoplasm, but some writers use the words synonymously, while others have assumed a difference without making a clear distinction between the two terms. Neither do the definitions as given in Webster's New International Dictionary, second edition, 1935, help to clarify this confusion.

Since, in biology, there are two types of multinucleate masses of protoplasm with respect to ontogeny and since there are in use two terms for such structures, it seems highly desirable that the terms be differentiated and used consistently in the interest of proper comprehension and exact expression. The two ontogenetic types of such structures are: (1) an enlarged protoplast, the nuclear divisions of which have not been followed by cytoplasmic cleavage, and (2) a protoplasmic mass formed by the fusion of several protoplasts without the fusion of the individual nuclei. Examples of the former are: the filaments of Vaucheria and Rhizopus, segments of Cladophora filaments and Hydrodictyon nets, embryo sacs of seed plants, latex cells and striated muscle fibers. Examples of the second category are young xylem tracheae, latex vessels and young plasmodia of Myxomycetes.

The term coenocyte should be used in connection with the first type of structure described above, and syncytium with the second. This distinction was clearly brought out in S. H. Vines's "Textbook of Botany," 1895, pp. 90–91. In response to a letter of inquiry sent recently to the editors of Webster's New International Dictionary, the same interpretation was held: ". . . the multinucleate structures that are called *coenocytes* arise . . . by enlargement, along with nuclear divisions, of single protoplasts, while the multinucleate structures that are called *syncytia* arise by the uniting of separate protoplasts."

About the only distinction one can find in modern biological literature is that zoologists as a rule use only the term syncytium, while botanists tend to use coenocyte nearly to the exclusion of the other term!

REXFORD F. DAUBENMIRE

THE UNIVERSITY OF IDAHO

THE BLACK WIDOW SPIDER IN VIRGINIA

IN his note entitled "New Localities for the Black Widow Spider" in SCIENCE for November 13, 1936, Lowrie makes the statement that this spider has not

been officially recorded from Virginia. This must come as a surprise to the naturalists of the state, since the black widow must be fairly prevalent all over the state, so much so that nobody has considered it significant enough to record its occurrence. Around Farmville it is rather common. A few minutes hunt under old logs, fence rails, etc., is almost certain to unearth a specimen, and scarcely a year passes that specimens are not brought into our laboratory.

G. W. JEFFERS

STATE TEACHERS COLLEGE
FARMVILLE, VA.

SPECIAL CORRESPONDENCE

NEW ENGLAND INTERCOLLEGIATE FIELD TRIP

THE 32nd annual meeting of the New England Intercollegiate Geologists was held on October 10, 11 and 12, at Littleton, New Hampshire. Dr. Marland Billings, of Harvard University, was in charge of the various trips, and was assisted by Dr. Arthur B. Cleaves, Dr. Charles R. Williams and Jarvis B. Hadley. The field excursions were planned to illustrate the geology of the Franconia, Littleton, Moosilauke, Mount Cube and Woodsville quadrangles. The geology of these quadrangles has recently been studied by those who led the trips.

On Saturday, October 10, more than 100 geologists were in the parties led by Billings and his associates, to study the stratigraphy and structure of the Ordovician (?), Silurian and Devonian rocks under conditions of epi-zonal (low-grade) metamorphism. The Highlandcroft granodiorite was studied in its type locality where it is separated by an unconformity from the overlying middle Silurian fossiliferous Fitch formation. The slates of the lower part of the Littleton formation (lower Devonian) and overlying volcanics were also seen. Continuing upward in the stratigraphy, the slates and sandstones of the upper part of the Littleton formation were viewed where an Oriskany fauna had been obtained. Finally, the Ammonoosuc volcanics, of upper Ordovician age, consisting of soda-rhyolite, volcanic conglomerate and soda-rhyolite tuffs, were seen. Localities at which the Ammonoosuc thrust fault is observable were also visited.

Three trips were conducted on Sunday, October 11, by Drs. Billings, Williams and others. Dr. Billings conducted a study of the Paleozoic rocks in areas where they showed mesozonal and katazonal metamorphism. Excellent fossils were found in the mesozonal Fitch along the Ammonoosuc near Gale River. Along Gale River the mesozonal Littleton is well exposed. Near Northey Hill the geologists studied the exposures of the Ammonoosuc volcanics, the Clough conglomerate, the Fitch formation and the Littleton formation on the limbs of the Garnet Hill syncline. In this same area the Littleton formation yields many excellent staurolite crystals. The Bethlehem granodiorite gneiss, with well-developed north-south vertical foliation and a pronounced vertical linear feature, was seen east of Swiftwater. The final stop of the trip was at Lost River, where both the Littleton formation and the Kinsman quartz monzonite are in the katazone.

Dr. Williams conducted a trip to the summit of Mount Hale and pointed out the compelling evidence for mapping the Mt. Garfield porphyritic quartz syenite as a ring-dike. This ring-dike is an arcuate body, 13 miles long and varying from one quarter to one mile in width. It forms approximately 100° of arc. The leader suggested that field evidence indicated that the syenite was intruded along some fracture or fracture system and fulfilled the requirements of a ring-dike. On the trail the party also studied the Devonian Talford schist, a gray quartz mica schist, with occasional garnet and sillimate, injected by sills and dikes of granitic material of the New Hampshire magma series.

A special glacial trip was led by J. W. and R. P. Goldthwaite, G. W. White and R. J. Lougee in the Whitefield and Mount Washington quadrangles to see the classic Bethlehem moraine (?). The Twin mountain ice contact deposits, the Zealand Esker, a delta near Meadows and a series of spillways, near Jefferson, and their associated deposits were examined. The trip concluded with a view of the low divide (spillway?) between the Connecticut and the Androscoggin drainage at Bowman and a view of the ravines and cirques on the north slope of Mt. Washington. R. P. Goldthwaite summarized some of his findings of his recent studies on the date of cirque cutting.

On Monday, October 12, a trip, led by Dr. Williams, was conducted to see the Franconia "breccia" and the Conway granite at the basin, and the deep post-glacial weathering of the Conway granite. This group also visited the Flume and Lost River, and at the former locality, Dr. Williams demonstrated that the Flume has been eroded along a series of trap dikes.

On the same day Jarvis Hadley led a trip within the Moosilauke and Mt. Cube quadrangles. Owl's Head dome, one of the great igneous domes of western New Hampshire, was viewed. One of the most striking features of this trip was the readily discernible evidence of the three-fold repetition of the Clough

conglomerate by thrust faulting on Sugar Loaf Mountain, southeast of Center Haverhill. About two miles south of Pike, the Blackberry schist was studied. Here many small zigzag folds were noted. Eastward, on the higher hills, the southward extension of the Northey Hill thrust fault was observed. Later, a section through the Blackberry formation, the Pike Volcanics and the Albee formations was seen. The Mascoma igneous dome was viewed at the end of the trip.

The general plan followed by Dr. Billings and his co-workers illustrated the stratigraphic sequence in proper order; showed conclusively the collected evidence of lithological change in any formation due to progressively increasing metamorphism from northwest to southeast; showed fossiliferous horizons which aided in dating the formations; and, finally, the sequences, structures, contact effects and intrusives of the various magma series. All the attending geologists agreed that the trips were exceptionally well organized, well prepared and most instructive.

At the general business meeting of the association on Friday evening, 118 people, representing 24 colleges, were in attendance. Dr. Lloyd W. Fisher, of Bates College, was selected as secretary-treasurer to succeed the late Dr. Edward H. Perkins. The College of the City of New York will be host at the annual field meeting in 1937.

LLOYD W. FISHER,
Secretary, New England Field Geologists' Association

SCIENTIFIC BOOKS

AN INVITATION TO MATHEMATICS

An Invitation to Mathematics. By ARNOLD DRESDEN. xiii + 453 pages. 1936. Henry Holt and Company. $2.80.

WHILE this book serves as basis for a course in first-year college mathematics, it departs strikingly in form and content from the traditional text-books familiar to all who have been exposed to required freshman work in this field. The author aims to present to his readers some broad vistas of mathematical development, expecting of course more than passive and cursory attention but demanding very little in technique. The reader may hope to find not only much of the charm and symmetry of mathematics but as well a lively appreciation of the fundamental significance for modern life of the expanding achievements of mathematical science. The treatment follows neither a rigid pedagogical, logical nor historical form but draws together in a moving net of conversation, suggestion, warning and proof many topics often isolated, some of which are seldom accessible to the college undergraduate. In addition to material in analytic geometry and in the calculus one finds much time devoted to number theory, non-Euclidean geometry, postulational systems, projective geometry, geometry of the triangle, differential geometry, etc., including even the four-color problem, Fermat's unproved theorem and the syllogism. In a work of this kind the choice of interesting problems within the technical scope of the reader presents a challenge met with singular success. The book is the outcome of several years of classroom experiment by a scholarly, reflective and sympathetic teacher. The chapter and section headings appear in picturesque allegorical phrasing, almost equally adapted, one might imagine, to describing "The Wonders of Geology," "The Rise of the Italian Renaissance" or "The Romance of Cleopatra." The "Contents" is thus useless for purposes of reference, but the remarkable collection of indices at the back sets a standard to appease prosaic-minded critics.

ALBERT A. BENNETT
BROWN UNIVERSITY

British Association Mathematical Tables. Vol. V. Factor Table. By J. PETERS, A. LODGE and E. J. TERNOUTH, E. GIFFORD. xv + 291 pp. London, 1935. 20s.

THOSE who have to do with the peculiarities and mysteries of whole numbers, whether they be amateur or only professional number theorists, will be interested in this unique factor table. The particular usefulness of this table is not due to its extent—tables covering up to 100 times as much territory may be had—but rather to its completeness. Larger tables usually omit those numbers which are multiples of 2, 3, 5 or even 7 and give only the smallest prime factor of each number in the table. The present table gives for each number up to 100,000 its complete decomposition into primes, thus giving at a glance information which, if the larger type table were used, might require three or four divisions, consulting the table each time at a different page. Another feature of the table is the manner in which primes are represented. While larger tables merely leave a blank entry to indicate a prime, in the present table the primes are printed in bold face so that the reader is assured of having entered the table correctly. Of course these advantages are not gained without a sacrifice of space. Most pages cover only 350 numbers, as compared with 21,000 in Lehmer's table. No attempt is made to crowd the page with figures.

From the introduction it is evident that the table is

one of the most accurate ever published. Three copies of the table were prepared by different authors by quite different methods and these copies were collated six times. The table has also been read against nine other tables, and lists of errors in these latter are given in the introduction, together with a bibliography of 15 factor tables beyond 100,000.

It need hardly be said that for problems necessitating the rapid and frequent examination of five figure numbers this table will prove immensely practical. The need for such a table was first pointed out by Cayley more than sixty years ago. It is interesting to note from the introduction that a well-known New England manufacturing firm has published eight editions of a similar table to 10,200 for use in gear design.

The publication of the present table was made possible by a bequest of Lieutenant-Colonel Allan J. C. Cunningham, a veteran table maker and author of more than forty major tables in the theory of numbers, to the British Association for the Advancement of Science, whose committee for the calculation of mathematical tables is responsible for the preparation of the table.

D. H. LEHMER

LEHIGH UNIVERSITY

SPECIAL ARTICLES

INACTIVATION OF TOBACCO-MOSAIC VIRUS BY X-RAYS[1]

RECENT experiments of the writers have shown that tobacco-mosaic virus is inactivated by exposure to x-rays from a copper target having a characteristic K radiation of 1.537 Å. The virus used in the experiments was extracted from diseased *Nicotiana tabacum* L. var. Turkish plants. It was adjusted to about pH 7 by addition of approximately 3 grams of $Na_2HPO_4 \cdot 12H_2O$ per 100 cubic centimeters, filtered through a layer of celite (Hyflo Standard-cel), and then through a Berkefeld "N" filter candle. The solution thus obtained was placed in small Syracuse watch glasses and allowed to dry for 18 or more hours. It was exposed to x-rays at a distance of 5.0 centimeters from the copper target. After exposure the virus was taken up in a solution composed of a mixture of 0.1 molar K_2HPO_4 and 0.1 molar KH_2PO_4 at pH 7. Quantitative measurements were made by counting the numbers of necrotic lesions produced in *Phaseolus vulgaris* L. leaves inoculated with the virus samples tested. The data show that the survival ratios for virus exposed to x-rays follow a simple exponential curve with a slope of $e^{-0.079t}$, where t is equal to the time of exposure in minutes. The curve, plotted on semi-logarithmic paper, is shown in Fig. 1. The type of curve obtained suggests that the absorption of a single unit of energy in a virus particle is sufficient to cause inactivation of the particle.

The same type of curve is applicable to the killing of many living things by x-rays. The survival ratios for bacteria, *B. coli*, *B. aertrycke* and *Staphylococcus aureus*, exposed to x-rays follow this type of curve.[2]

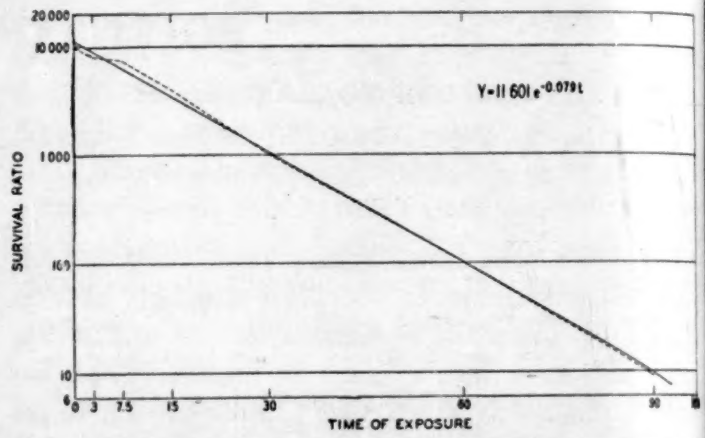

FIG. 1. Survival curve of tobacco-mosaic virus exposed to x-rays from copper. The time of exposure is shown in minutes. The dash line presents the averages of six experiments. The total lesion counts for these data were 127,264.

Drosophila melanogaster sperm are killed in a like manner.[3] Results obtained with *Drosophila* sperm are of particular interest because of their analytical possibilities. Irradiation of *Drosophila* sperm by x-rays of wave-lengths from 2.29 Å to 0.7 Å, or less, results in death of the sperm, the production of lethal rearrangements in the chromatin (either within the gene or the linin thread) and gene mutations. Each of these characteristic effects of radiant energy may be expressed by exponential curves. The best evidence available indicates that the gene is a single unit capable of reproducing itself some time during the cell cycle. Absorption of energy within this unit may cause alterations leading to one or more of the effects mentioned above.

The virus of tobacco mosaic is composed of particles the size of which is estimated to be of the same order as that of genes. Tobacco-mosaic virus also resembles

[1] The writers are pleased to acknowledge their indebtedness to Dr. R. W. G. Wyckoff for the use of his x-ray equipment.

[2] R. W. G. Wyckoff, *Jour. Exp. Med.*, 52: 435, 1930; *ibid.*, 52: 769, 1930; *Jour. Gen. Phys.*, 15: 351, 1932; R. W. G. Wyckoff and T. M. Rivers, *Jour. Exp. Med.*, 51: 921, 1930.

[3] John W. Gowen and E. H. Gay, *Genetics*, 18: 1, 1933; for a general survey and literature on biological effects of radiant energy, see "Biological Effects of Radiation," edited by B. M. Duggar, McGraw-Hill Book Company, 1936.

genes in other respects; both are incapable of reproduction outside of living cells, they produce similar effects, as, for instance, variegation or mottling, in plants, and they are, under natural conditions, capable of mutating to new forms which retain the ability to reproduce themselves. The virus differs from genes in being able to move from cell to cell and in being capable of inoculation into the cells of healthy plants. The fact that tobacco-mosaic virus is inactivated by radiant energy of the x-ray and ultra-violet[4] bands in a manner similar to that of genes suggests an alteration in the virus particles comparable to that which takes place in genes.

JOHN W. GOWEN
W. C. PRICE

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH,
PRINCETON, N. J.

VERTEBRATE REMAINS FROM CENOZOIC ROCKS

VERTEBRATE remains from the sediments filling the Rio Grande Basin of northern and central New Mexico are fairly common, yet they are not so common as to deserve no notice when new bones appear. Moreover, fossils from these sediments always lend assistance in the interpretation of the complicated history of this great trough. Although good exposures of valley fill are plentiful in Socorro County, fossil remains from the fill are very scarce.

In April, 1935, the writer unearthed the complete lower jaw of a four-tusked mastodon from the fill about six and one half miles northeast of Socorro, along the south bluff of Arroyo de la Parida. The material in this exposure is unconsolidated sand and gravel, light in color, poorly sorted and highly cross-bedded. The pebbles are much waterworn and are made up of a wide variety of igneous and metamorphic rocks, with a few fragments of sedimentary rocks. Unquestionably, the material was laid down by a river flowing in the basin near Socorro.

Photographs of the jaw and a plaster cast of the teeth were sent to Dr. C. L. Gazin, of the United States National Museum, for study. Dr. Gazin has kindly reported that the jaw apparently belongs to the genus *Rhynchotherium* and that its age is certainly upper Tertiary, probably upper Pliocene.

In February, 1936, Mr. Martin Dykers, a senior in the New Mexico School of Mines, discovered a horse tooth in the same exposure. The tooth was reported by Dr. Gazin to be a lower left molar and is tentatively referred to the genus *Plesippus*. The age, Dr. Gazin states, is apparently upper Pliocene.

Thus, some of the basin deposits near Socorro, generally referred to the Santa Fe formation, are rather definitely proved to be upper Pliocene in age.

About 14 miles south of the above locality, the writer obtained another small collection of bones from the base of a bed of pumicite. This bed is located about three and one half miles northeast of San Antonio, Socorro County, along the east bluff of the Rio Grande. It is underlain by some thirty feet of light-colored gravel and sand and buff silt, typical of the Santa Fe formation as developed east of the Rio Grande near Socorro.

The bones from the pumicite were kindly determined by Dr. A. Wetmore of the United States National Museum to be parts of the humerus, ulna and radius of the turkey, *Meleagris gallopavo*, not distinguishable from those of the modern turkey. According to Dr. Wetmore, this species of turkey has not been reported anywhere from Pliocene deposits, and from Pleistocene deposits only in Pennsylvania, Tennessee, Arkansas and Florida.

Professor Kirk Bryan, after a recent visit to this exposure, expressed an opinion, based on stratigraphic and structural evidence, that the pumicite might be a part of the upper Pliocene deposits. The fossil evidence, however, favors the Pleistocene for its age, although there is no reason why this species of turkey should not occur in Pliocene deposits. The relation of the pumicite to the underlying and overlying sediments and, consequently, the age of the bones can be determined only after more careful field work in the vicinity. In any event the bones are as old as early Pleistocene and hence are a contribution to the paleontology of the Southwest.

C. E. NEEDHAM

NEW MEXICO SCHOOL OF MINES

CONTAMINATION AND COMPACTION IN CORE SAMPLING

FOR a number of years marine sediments have been sampled by means of coring instruments of various types. The cores obtained have been sectioned; mechanical and chemical analyses have been made; and in some cases, micro-fossil studies have been undertaken. This detailed work has been accomplished with little regard for the contamination of the materials which may have taken place as the core sample was obtained. Also, the vertical extent of the material being dealt with before coring was not considered. Therefore, an investigation of this method of sampling seemed desirable.

An opportunity to carry out such a study was obtained during the summer of 1936 spent at the Woods Hole Oceanographic Institution with the helpful guidance of Mr. H. C. Stetson. The magnitude of the contamination taking place was determined by a num-

[4] W. C. Price and John W. Gowen, in press.

ber of simple laboratory experiments. Samples of a bright red clay, a fine green glauconitic sand and a buff-colored clay were slaked down and layered in a glass-sided aquarium tank, two and one half, by three, by two feet in dimension. The buff clay was placed on the bottom, the green sand over that, and the red clay as the surface material. Mechanical analyses were made of the fine green sand and the buff clay, which gave median diameters of .129 mm for the sand and .062 mm for the clay. The red clay presented a problem in obtaining deflocculation of the finer particles; and as time was short, the median diameter was not determined. However, the texture appeared to approximate that of the buff clay. Cores were then taken in these layered sediments by plunging the instruments in by hand. The two types of instruments which are most commonly used were tested, a brass tube, one and one half inch in diameter, and a three quarter inch glass tube which is inserted in a metal pipe when in actual use. In every case observed the soft red clay surface material was found to have smeared the entire length of the outer surface of the core, which left only a part of this material in its original position at the upper surface of the core. The base of the green glauconite layer showed a sharp, clean-cut contact, while the top of this green glauconite layer presented a zone of contamination from one half to one inch wide in which the red clay was mixed with green glauconite grains.

The second phase of the problem, the compaction which results from the instrument plunging into the sediments, was studied by actually obtaining core samples of the numerous types of bottom materials present in the vicinity of Woods Hole and Massachusetts Bay. The outer surface of the coring instrument was carefully cleaned and coated with shellac before each core was taken. In that manner the exact depth of penetration of the instrument could be determined as particles of the sediment clung fast to the sticky shellac. The length of the core was determined before removing it from the instrument, and the amount of compaction could then be calculated. The figures given below in Table I are averages of not

TABLE I

ILLUSTRATING THE COMPACTION TAKING PLACE DURING CORE SAMPLING. PENETRATION WAS DETERMINED BY SHELLACKING OUTER SURFACE OF CORING INSTRUMENT

Character of bottom	Penetration	Length of core	Compaction
Soft mud over sand	5′ 11.25″	3′ 2.85″	2′ 8.4″
Soft mud	6′ 8.6″	3′ 2.4″	3′ 6.2″
Soft mud (Lowering tube slowly)	4′ 1.3″	1′ 10.6″	2′ 2.7″
Sand bottom	1′ 8.1″	1′ 1.6″	6.5″
Sandy silt	2′ 9″	1′ 5″	1′ 4″

less than six cores taken in each type of material. The fact that the relative depth of penetration and the length of core remained constant in a particular type of sediment indicated that a true picture of the compaction taking place was obtained.

CONCLUSIONS

The results obtained from the experiments on contamination suggest three points which should be observed when taking samples from a core.

(1) The outer surface of the core should be eliminated from the sample. This may be done by simply drying the core and scraping off the outer surface or slicing the core lengthwise and removing the sample from the center.

(2) The presence of the zone of contamination between the layers of fine sand and the red clay indicated the possibility of contamination at the contact of two sediments of varying texture. Taking samples close to such a contact should be avoided.

(3) If the surface material is of fine texture any analyses such as a mechanical analysis of the material being deposited under present-day conditions or the determination of the food value for sea life in the material at the bottom of the sea could not be done accurately by analyzing the material at the top of such a core sample. The surface material would be smeared down the length of the core and compacted.

From the figures given above it is clear that the vertical extent of material being dealt with in a core is much greater than the apparent extent shown by the length of the core itself. The exact extent, however, can not yet be shown; as it seems reasonable to believe that the material say two feet below the surface will compact less than the material at the surface as the instrument penetrates it. Thus, the true vertical extent of the material dealt with could be determined only after a curve showing the decrease of compaction taking place in a coring tube with depth has been established.

WILLIAM F. WRATH

UNIVERSITY OF ILLINOIS

BOOKS RECEIVED

Archivos do Museu Nacional. Vol. XXXVI, 1934. Pp. 116. Illustrated. Museu Nacional, Rio de Janeiro.

BAILEY, J. H. SHACKLETON. *Elementary Analytical Conics.* Pp. 378. Oxford University Press. $2.75.

HOYLE, RAYMOND J. and LAURIE D. COX, Editors. *A History of the New York State College of Forestry, 1911–1936.* Pp. 177. The College, Syracuse.

MURRAY, P. D. F. *Bones: A Study of the Development and Structure of the Vertebrate Skeleton.* Pp. 203. 45 figures. Cambridge University Press, Macmillan. $2.50.

ROSENDAHL, CARL O., FREDERIC K. BUTTERS and OLGA LAKELA. *A Monograph on the Genus Heuchera.* Vol. II in the Minnesota Studies in Plant Science. Pp. 180. 5 figures. University of Minnesota Press. $3.00.

VAN DYKE, H. B. *The Physiology and Pharmacology of the Pituitary Body.* Pp. xvii + 577. 55 figures. University of Chicago Press. $4.50.